TECHNICAL
AND
COMMISSIONING MANUAL

CSR
70

AUTOMATIC SYNCHRONISER
" C O S "

Doc 183/1

MOD	le ETABLI par	le VERIFIE par	le APPROUVE par	MODIFICATIONS

	DATE	NOM	VISA	ECH
ETABLI	16-02-84	MURET		
VERIFIE	1-3.84	POTIÉ		
ROUVE	1-3-84	CHEHU		

CGEE ALSTHOM 92309 LEVALLOIS-PERRET CEDEX - FRANCE

P-SM70-A41243-	FOLIO	VOIR
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I.- OBJECT

The COS coupling unit is designed to enable or to transmit a closing order to a circuit-breaker separating two sources or between main supply and user networks when the conditions specified by the user are fulfilled.

Two operating modes are possible as indicated below :

A - Synchronization monitoring

A contact is closed when the following three conditions are fulfilled :

. frequency deviation	ΔF	<	ΔF	max	Maximum frequency deviation
. voltage deviation	ΔU	<	ΔU	max	Maximum voltage deviation
. dephasing	φ	<	φ	max	Maximum phase-displacement.

Examples of use :

- Validation of manual coupling of an alternator.
- Validation of circuit-breaker operations in industrial networks where several power sources exist.
- Rapid transfer systems.

B - Synchronization

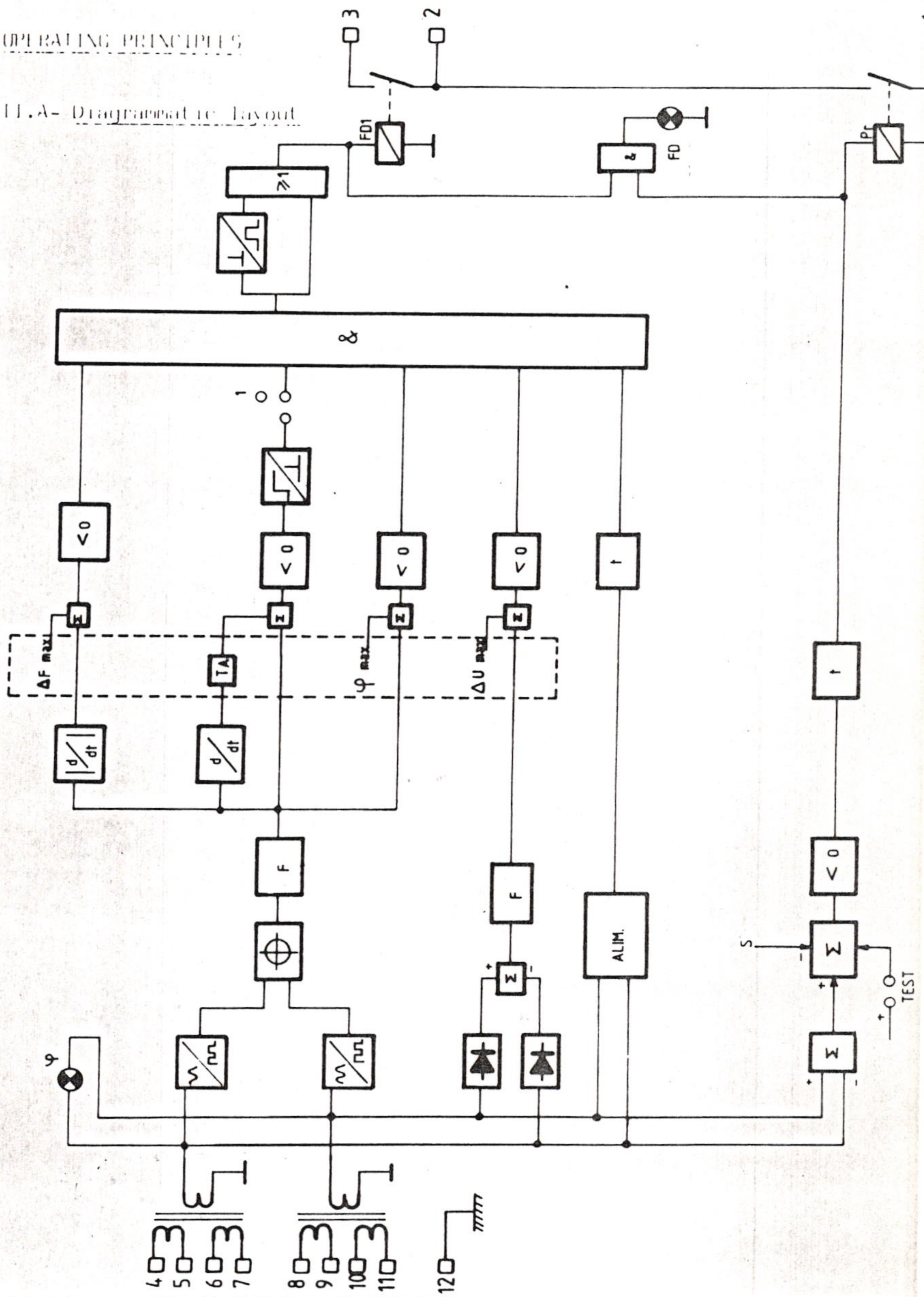
When operating in this mode, a contact closes with a lead time TA, equivalent to the closure time of the circuit-breaker, before the inphase period. The coupling operation is done perfectly inphase.

Examples of use :

- Automatic synchronizing of a low power alternator.
- Synchronizers SCS1, CS1, SCUS1 and UCS1 are more suitable for use with medium and high power alternators.

II. - OPERATING PRINCIPLES

II.A- Diagrammatic layout



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II.B- Analysis of diagram

1 - Power sypply sources

The two A C input voltages provide a direct current supply through two transformers and two floating rectifiers.

A voltage regulator supplies the stabilized power required (-6V +9V +15V) for the various circuits.

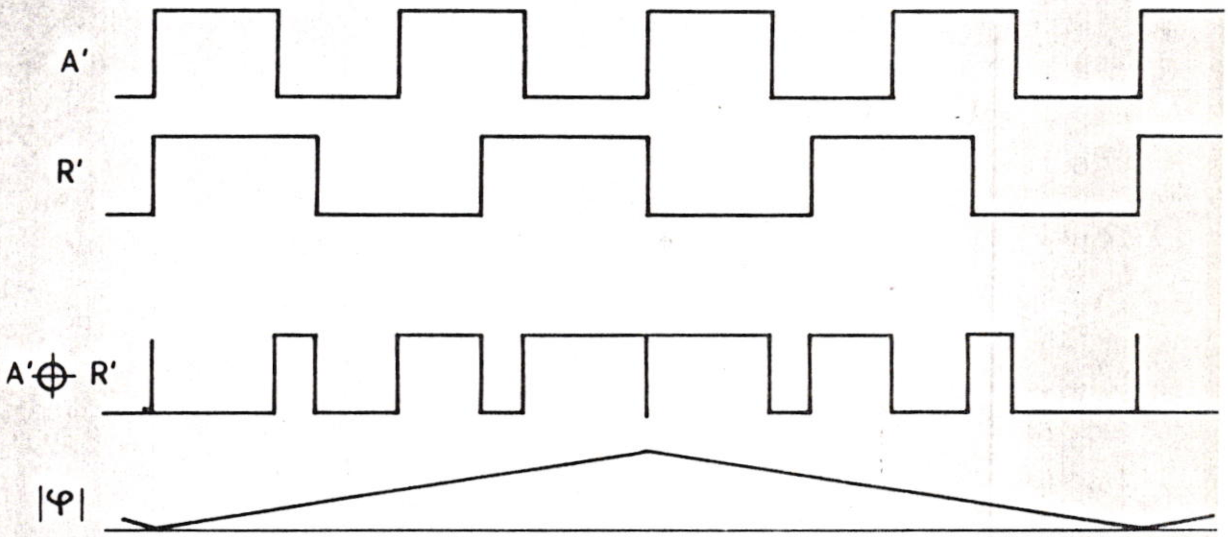
2 - Measurements

Voltage deviation $|\Delta U|$

The two power transformers also supply the 2 voltage measurements which are rectified filtered and compared. The comparison is therefore made between mean values which are proportional to RMS values if the voltages are sinusoidal : a second rectifier gives the absolute $|\Delta U|$ after comparison

Phase displacement φ

The 2 voltages taken on the same transformers as above are adjusted to give square signals A' and R'. A' and R' are applied to an "exclusive OR" followed by a 4 th. sequence filter giving |



Frequency deviation

Frequency deviation is calculated by taking the derivative of the phase displacement $\Delta F = k \frac{d\varphi}{dt}$

A rectifier circuit elaborates its absolute value $|\Delta F|$.

3 - Thresholds

The three measurements $|\Delta U|$, $|\varphi|$, $|\Delta F|$, are compared to 3 threshol ΔU max, φmax, ΔF max, respectively and give the following logic information :

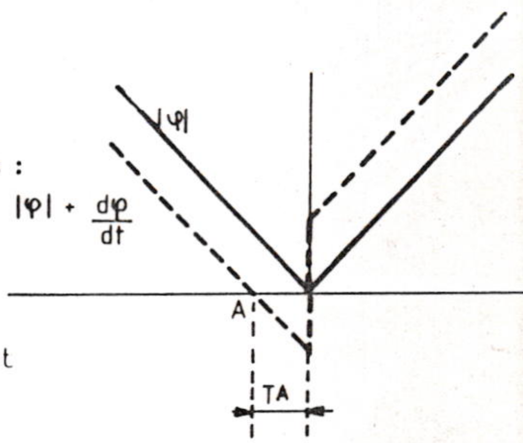
$|\Delta U| < \Delta U$ max

$|\varphi| < \varphi$ max

$|\Delta F| < \Delta F$ max

4 - Advance time TA

To elaborate a logic information for advance time TA before the inphase period, proceed as follows :



(1) $|\varphi| + \lambda \frac{d\varphi}{dt} = 0$

As the frequency deviation can be considered constant in the relevant time interval, we may write :

$\varphi = - kt \qquad \frac{d\varphi}{dt} = - k$

At point A : $- kTA - \lambda K = 0 \qquad TA = - \lambda$

We can see that whatever the frequency deviation may be (k), the advance time TA which is provided by the equation (1) is constant Adjustment of the constant λ of deviation controls the advance time TA.

5 - Sequential

A logic "AND" gives the final information for either a "synchronisation monitoring" or a "coupling operation".

A monostable prolongs the duration of the output instruction since the information T = TA would be too short for recording by the electro-magnetic relays.

6 - Protection

As the "COS" coupler is of single chain type, a single protection circuit will avoid couplings for an excessively high phase deviation, or voltage or frequency difference in the event of failure of components of the main chain.

The 2 sinusoidal voltages are compared, rectified and filtered.

The signal obtained is :

$$D = A \sin \omega_A t - R \sin \omega_R t$$

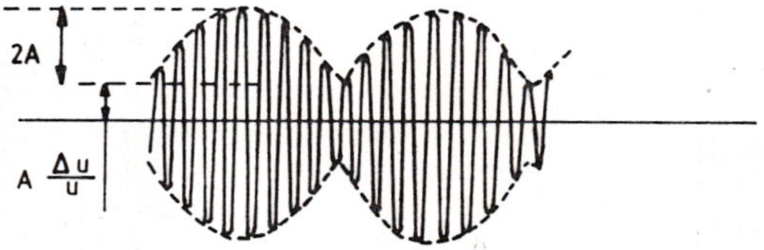
By writing : $\frac{\Delta u}{u} = \frac{A - R}{A}$ $\qquad R = A\,(1 - \frac{\Delta u}{u})$

The equation becomes :

$$D = A\,(\sin \omega_A t - \sin \omega_R t) + A\,\frac{\Delta u}{u} \sin \omega t$$

$$D = A\,[2.\ \mathrm{Cos}\,\frac{\omega_A + \omega_R}{2}\,t \times \frac{\sin \omega_A - \omega_R}{2}\,t + \frac{\Delta u}{u} \sin \omega_R t]$$

$$D \simeq A\,\{2\ \mathrm{Cos}\,\omega t\ \ \mathrm{Sin}\,\frac{\varphi}{2} + \frac{\Delta u}{u}\ \mathrm{Sin}\,\omega t\}$$



A detector compares D to a threshold S. This detector is followed by a time delay of 30 ms in order not to take into account the cos ωt or sin ωt which reverts to zero every 10 ms, but only sin $\frac{\varphi}{2}$ and $\frac{\Delta u}{u}$

The protection functions for :

$\varphi < 40^\circ$ → (for $\frac{\Delta u}{u} = 0$)

and $\Delta u < 50\%$ → (for $\varphi = 0$)

III.- FUNCTIONAL CHARACTERISTICS

. Input voltages :

A	4 5	110 V	110 V or 220 V at ± 20 % 6 VA, 48/62 Hz
	6 7	110 V	
B	8 9	110 V	110 V or 220 V at ± 20 % 6 VA, 48/62 Hz
	10 11	110 V	

. Output relays :

2 3	F.D	220 V.	2 A.	150 VA
2 1	P.R	127 V.	1 A.	50 W

(Fit surge arresters at terminals of commanded relays or breaker)

. Dielectric rigidity : Between A/ R/ Output contacts/ Earth
2000 V 50 Hz 1 mn/ 100 MΩ at 500 V DC

CEI 255-5.ANSI IEEE C 37-90-1978

. Climatic conditions : Operation : - 5° C + 50° C
Storage : - 25° C + 70° C

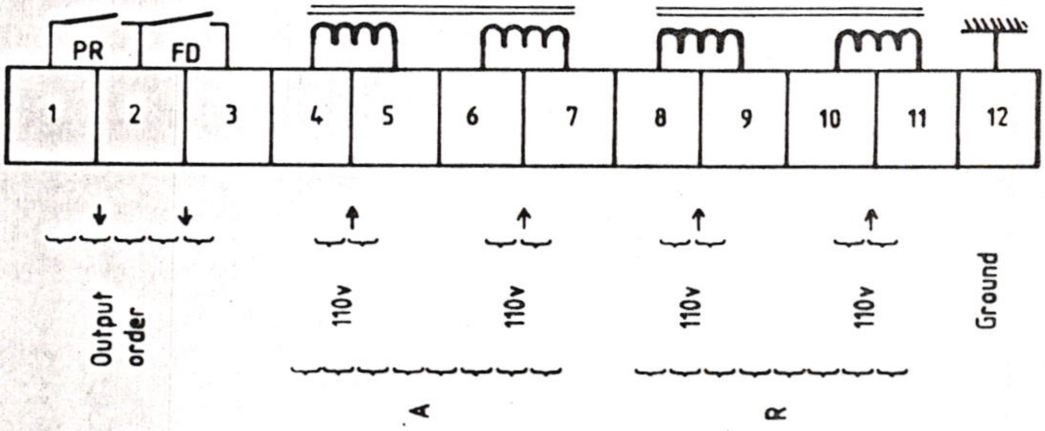
. Adjustment range :

ΔF max	0,1	to	0.75 Hz
Δu max	2	to	30 %
φ max	2	to	30 °
T_A	20	to	300 ms

. Precision :

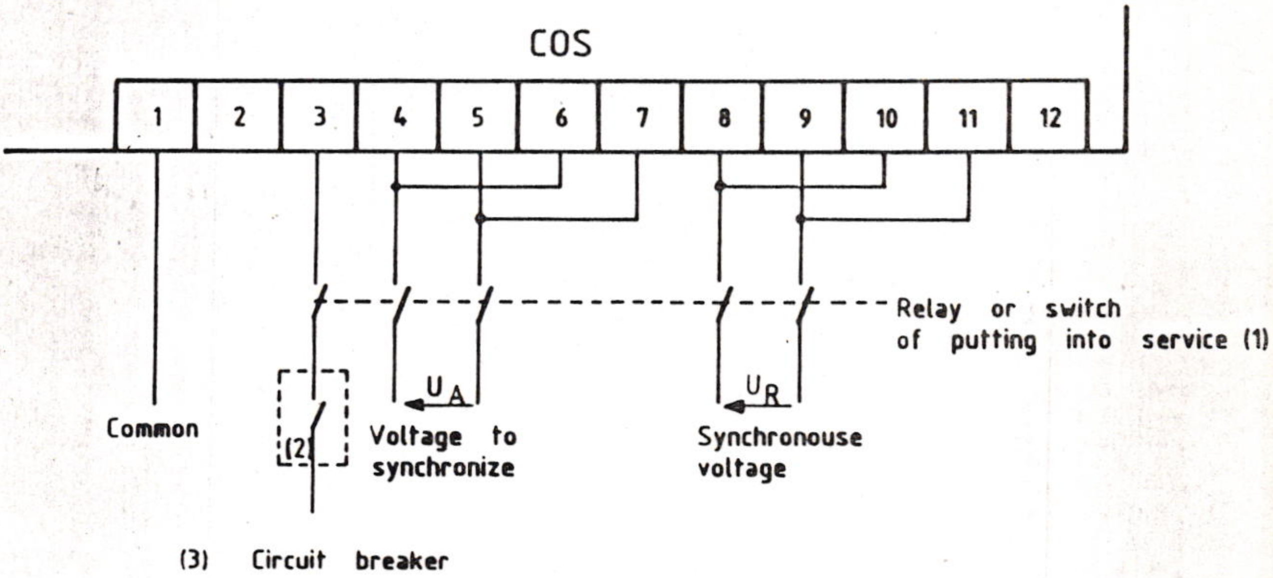
$\Delta F < \Delta F$ max	± (0,05 Hz + 10 % ΔF max)
$\Delta u < \Delta u$ max	± (2 % + 10% ΔU max)
$\varphi < \varphi$ max	± (2° + 10 % φ max)
T_A	± (20 ms + 10 % TA)

IV. - WIRING



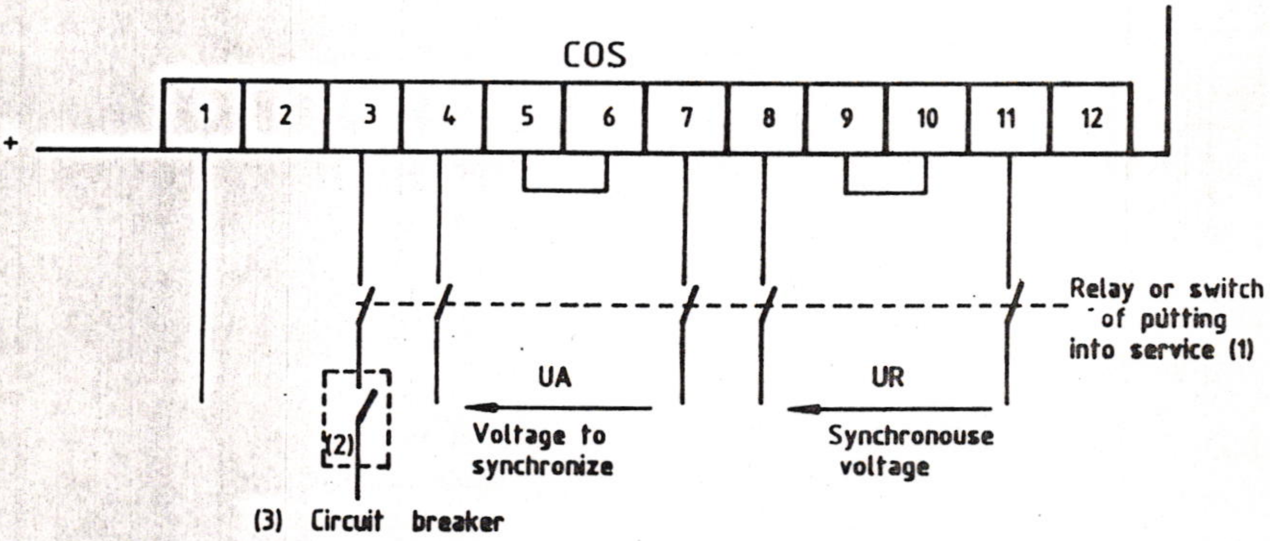
USE WITH 100 V - 110 V OR 115 V VOLTAGE TRANSFORMERS

Utilisation range 88 V to 132 V :



USE WITH 200 V OR 220 V VOLTAGE TRANSFORMER

Utilisation range from 176 V to 264 V :



Note 1 : The relay or switch (not supplied) nust be installed when it is not necessary to leave the COS permanently connected (alternator coupling). It can act as a switch or branching relay when the unit is controlling several circuit-breakers.

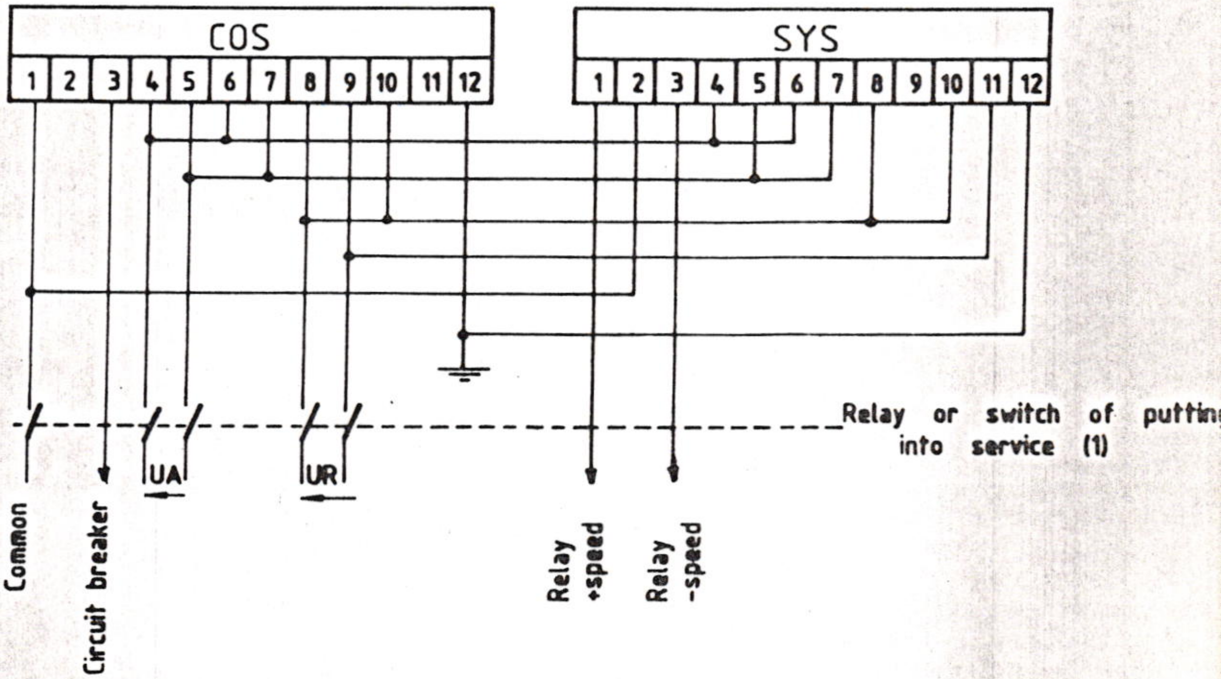
The COS can if necessary remain permanently connected.

Note 2 : The contact is the actual control of the circuit-breaker switch only when this switch is being validated by the COS when the latter is being used to monitor synchronisation.

Note 3 : If the circuit-breaker switch coil is too powerful, use an intermediate relay as necessary.

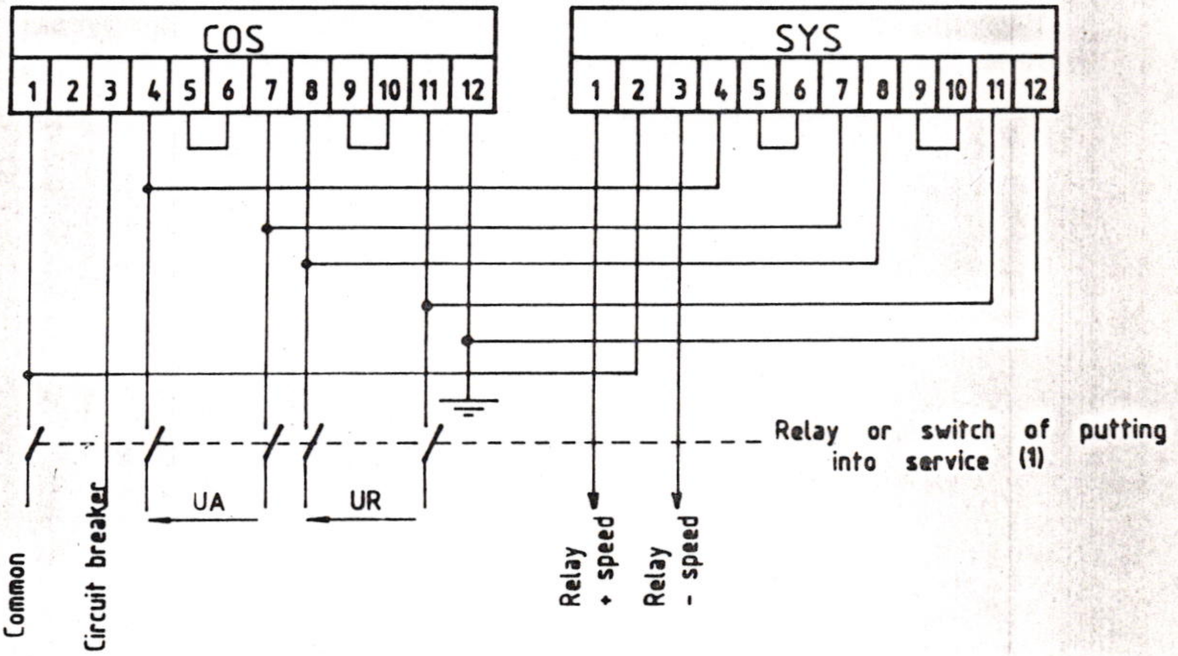
WIRING SHEME FOR A SYNCHRONIZING UNIT WITHOUT VOLTAGE EQUALISATION

Utilisation voltage 88 V to 132 V (VT : 100 V, 110 V or 115 V)



WIRING OF A SYNCHRONIZING UNIT WITHOUT EQUALISATION OF VOLTAGE

Utilisation voltage from 176 V to 264 V (VT 200 V, 220 V)



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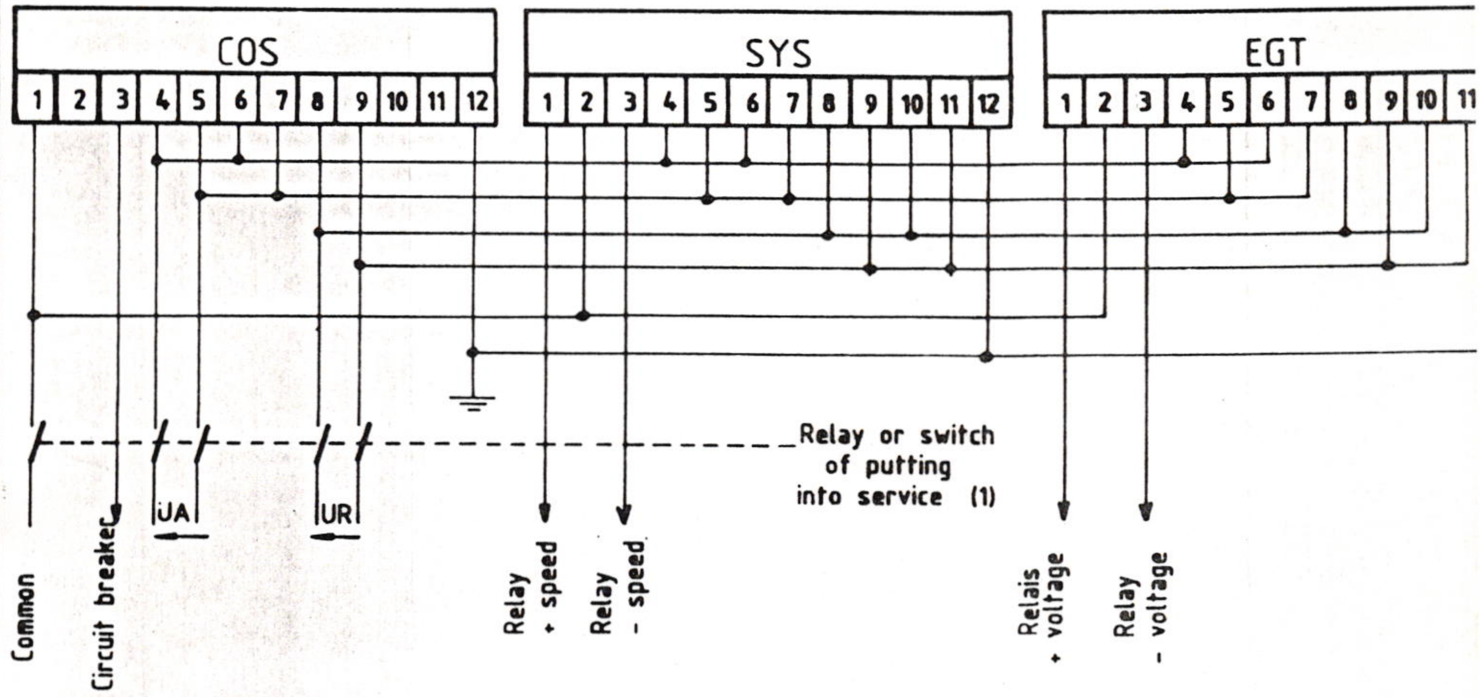
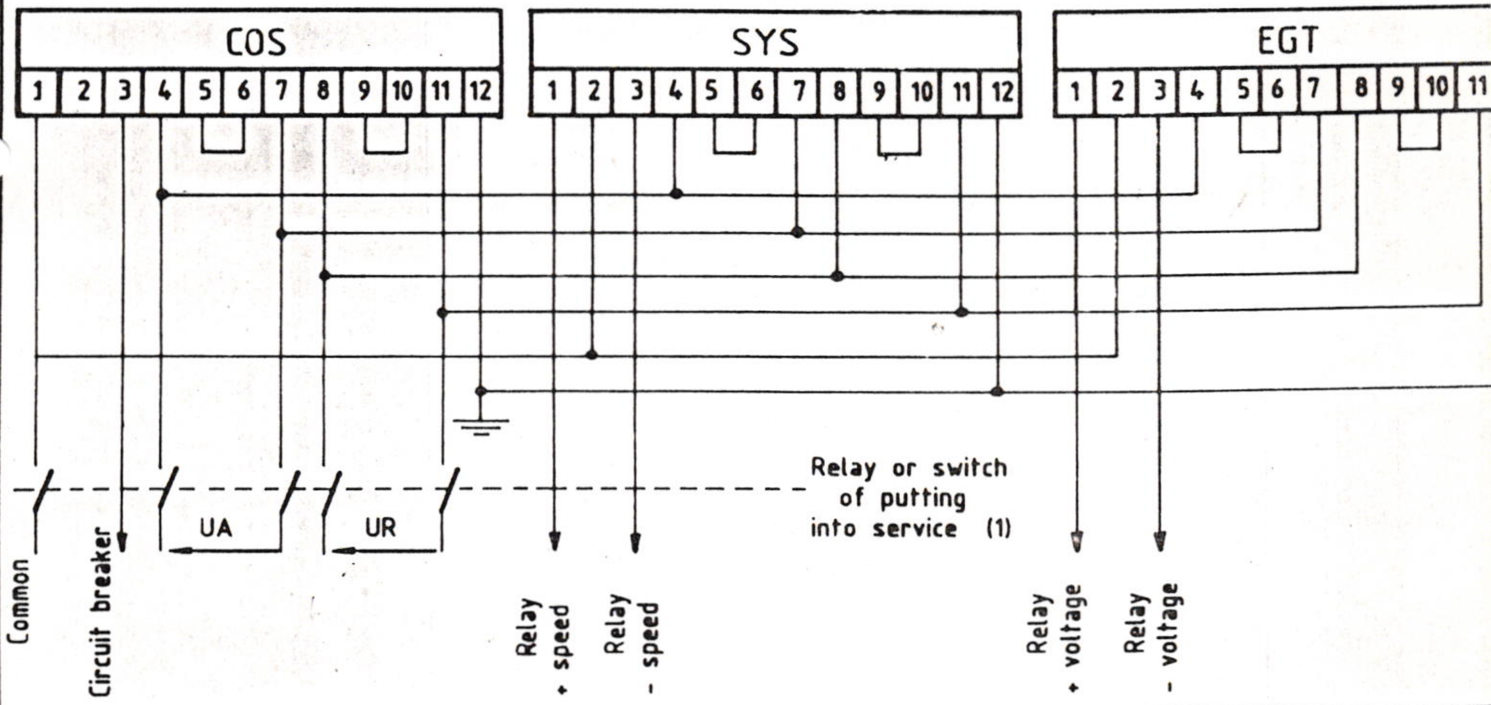
WIRING OF A SYNCHRONIZING UNIT WITH VOLTAGE EQUALISATION

Utilisation voltage 88 V to 132 V (VT 100 V, 110 V or 115 V)

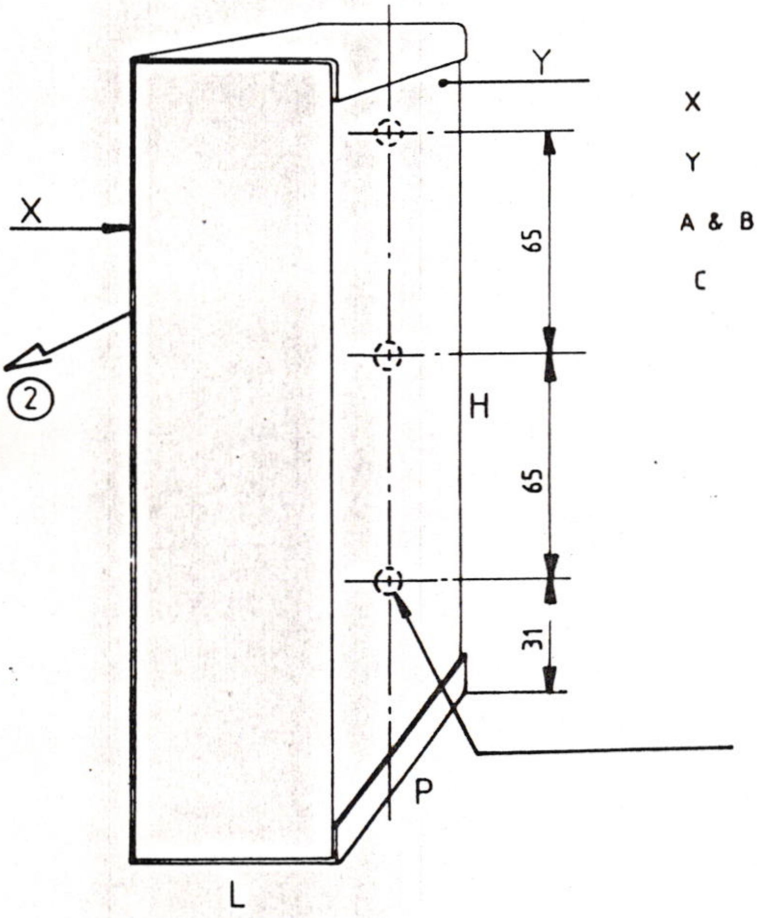


WIRING FOR A SYNCHRONIZING UNIT WITH VOLTAGE EQUALISATION

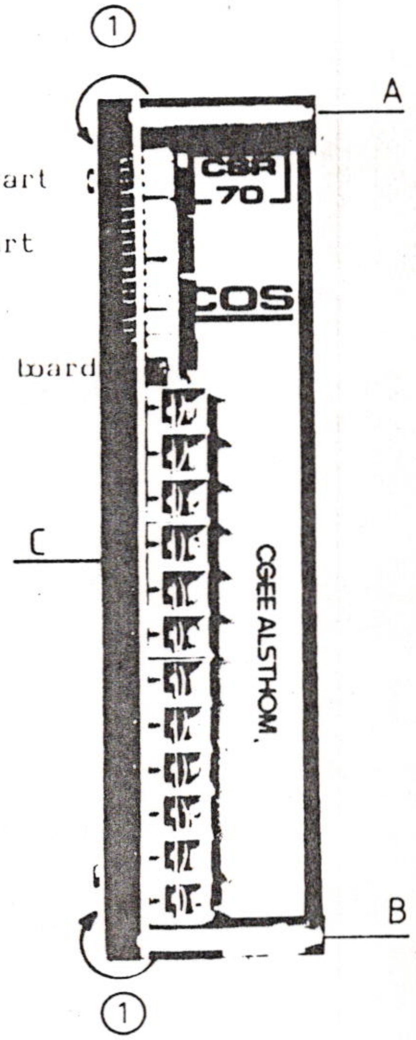
Utilisation voltage 176 V to 264 V (VT 200 V, 220 V)



V. DIMENSIONS



X : Moving part
Y : Fixed part
A & B : Bolts
C : Terminal board



V.1 Access to circuit

1 Compress to free bolts A and B

2 Extract part X for terminal board C connections

V.2 Overall dimensions

H = 192 mm Depth = 192 mm L = 50 mm

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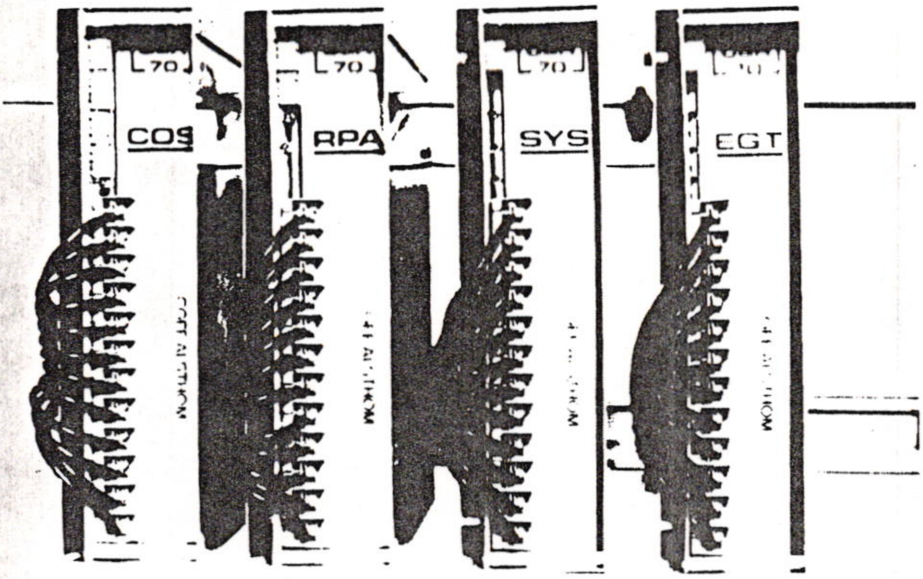
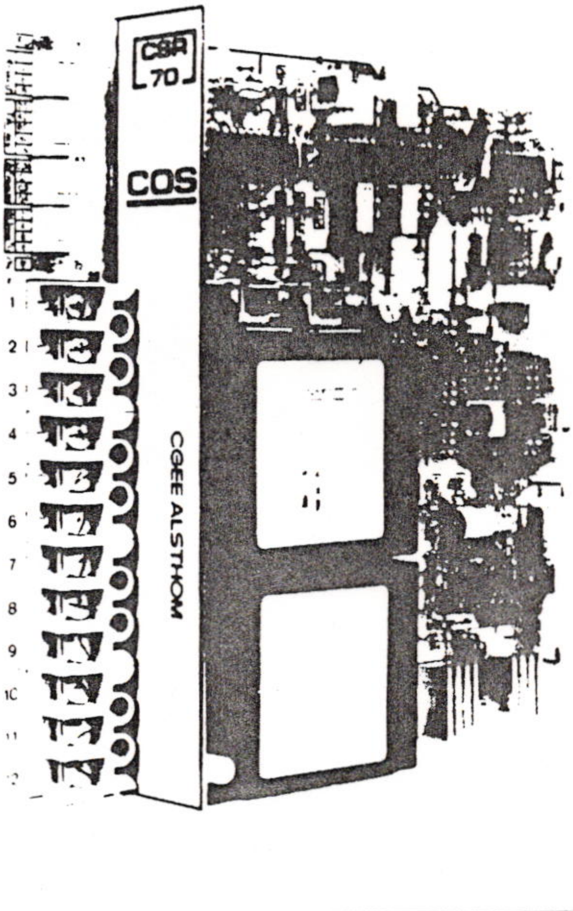
V.3 Assembly on din rail



V.4 Detail of the printed circuit



VI.- COMMISSIONING

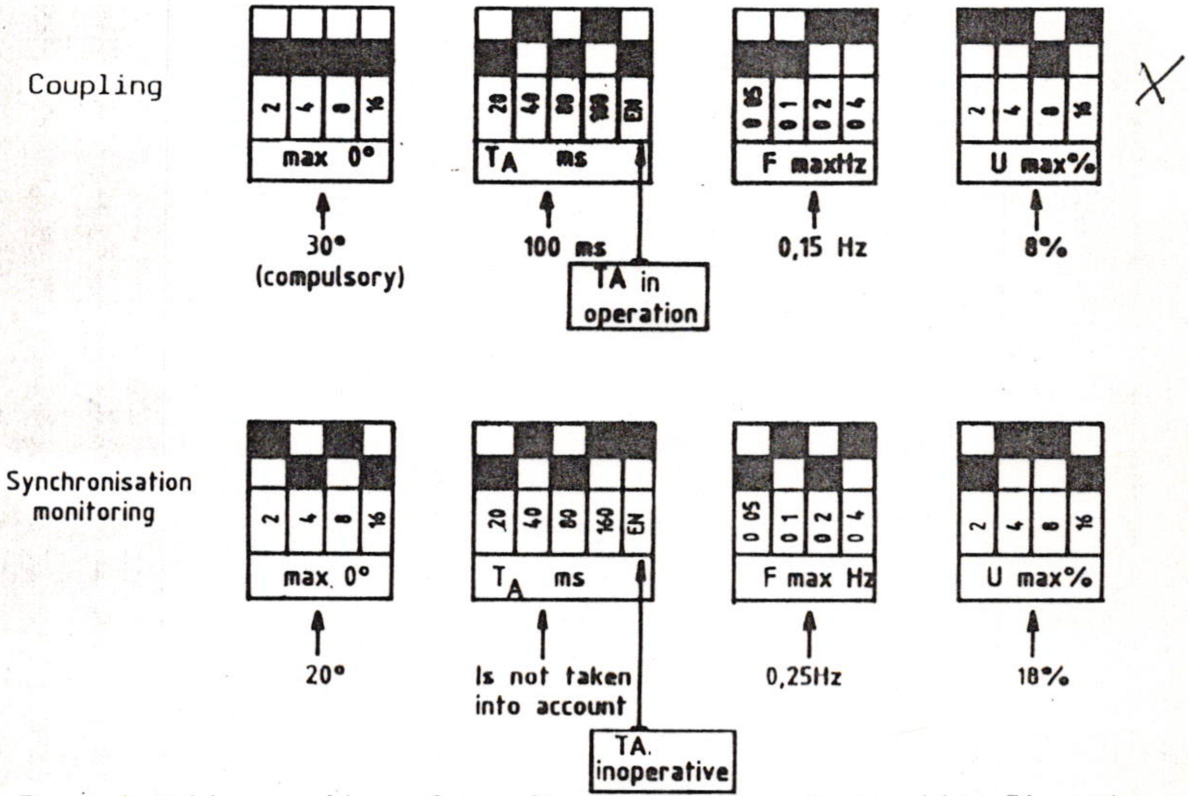
A.- Before putting into operation, inhibit output order.

B.- Check that the wiring and voltage levels are suitable for the unit, i.e. 110 V or 220 V at ± 20 %.

C.- Adjust parameters φ max, ΔU max, ΔF max and if applicable T_A if the synchronizing ; when T_A is used set φ max to maximum 30°.

Note : To adjust, use the small switches opposite each of which is a value. The set value corresponds to the total of the 4 values selected by pushing forward the cursors towards the frames wher these values are inscribed.

Example :



For automatic coupling of an alternator, the advance time TA must be used, by depressing the IN switch and setting φ max to 30°.

Adjust TA so that it equals the closing time of the circuit-breaker switch and the associated relays (to within approximately 20 ms).

Then adjust ΔF max and ΔU max as a function of the required synchronizing conditions.

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For synchronisation monitoring, the advance time TA must be disconnected by pulling the "IN" switch.

Then adjust ΔF max ΔU max and φ max as a function of the limit condition required.

D.- Energise unit and check that it is operating correctly :

- the signal light φ will flash at the frequency of the input voltage beat. It will be extinguished when the phase displacement is nil.
- The signal light FD will light when the two output relays are excited, i.e., when the conditions set by the unit are fulfilled.

E.- Close the circuit-breaker by hand having previously taken the necessary precautions.

If there is no wiring error, the coupler will be powered by two phase voltages.

The signal light φ should remain unlit.

If the unit is operating in synchronisation monitoring mode (TA disconnected), the signal light FD should be illuminated and the contact between terminals 1 and 3 closed.

If the unit is operating as a coupler (TA in), the signal light FD should be extinguished, contact between terminals 1 and 3 closed and the contact between 2 and 3 open.

F.- When these checks have been carried out, the coupler can be checked under operating conditions.

VII.- MAINTENANCE

The COS coupler requires no special maintenance.

The protection circuit may be easily tested. To make this test, short-circuit the two test points located on the front panel of the unit, then check that when the coupling conditions are effected, the signal light FD is no longer lit.

A more detailed test of the unit requires two frequency and variable voltage generators, a phasemeter, a frequencymeter, and a voltmeter.